

# Climate Smart Agriculture (CSA): Water Harvesting

Climate Smart Agriculture addresses the challenges which climate change (CC) poses to agricultural production. It is a pathway towards sustainable development and food security and is built on three pillars:

- Increasing agricultural productivity (crops, livestock and fisheries) and income
- Enhancing resilience or adaptation of livelihoods and ecosystems towards climate extremes
- Reducing and removing GHG emissions from the atmosphere (FAO 2016)

An agricultural technique or practice that contributes to the achievement of these pillars can be considered climate smart. But often, different techniques perform differently over the three pillars, and therefore have to be combined in an integrated CSA approach to complement each other and maximize their benefits (Worldbank 2015, FAO 2015).



## Climate-smartness Categories

In the 15 climate-smart villages established by CGIAR in Western Kenya for example, a farm is only counted as climate smart if it applies practices that are strong in all climate-smartness categories:

- Soil and water conservation structures
- Integrate perennial and annual crops
- Improved livestock enterprises
- Diversification of enterprises
- Readiness of a farm plan

Sometimes it is difficult to assess how climate smart a specific agricultural technology is in a certain context. Climate-smartness indicators, divided in three categories, try to indicate this and thereby support implementation.

- CSA-Technology indicators evaluate beforehand how well technologies will achieve CSA goals.
- CSA-Policy indicators assess to which extent the enabling environment (e.g. policies) support the implementation of CSA.
- CSA-Result indicators monitor the short term impacts of CSA interventions (Rawlins 2015).

The World Bank in collaboration with international partners has developed three indicator sets to support CSA implementation at the national and sub-national levels. The indicators will guide CSA investment decisions, and assist national governments, agricultural specialists and natural resource managers in evaluating the productivity and climate benefits of sustainable land management operations.

## How do you implement CSA?

CSA requires site-specific assessments to identify suitable agricultural production technologies and practices (FAO 2015).

## For Kenya adapted practices include:

- Soil and Water conservation measures increase ground cover and use little water.
- Manure and compost can decrease use of chemical fertilizers and adequate manure management for biogas production can reduce methane release.
- In agroforestry systems trees and crops coexist and benefit from each other.

## Activities that amplify Climate Change effects include:

- Inadequate tillage practices that expose the soil release carbon stored in the soil.
- Indiscriminate use and wrong timing of agrochemicals harm the ecosystem.
- Clearing land and burning plant biomass for farming releases carbon stored in the soil.

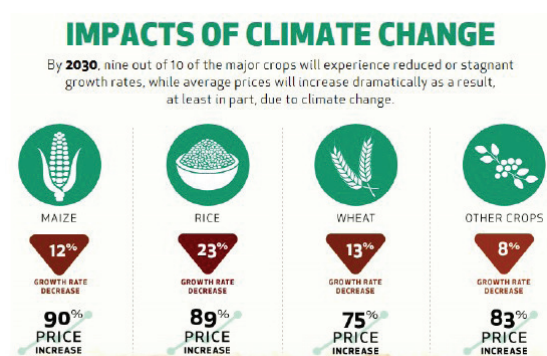
## Why CSA?

Therefore CSA is a basket of agricultural practices and techniques that not only aims at increasing profits and resilience for farmers but does so without harming, often even bettering, environmental parameters. It improves input efficiency, soil quality and benefit-cost returns for farmers while limiting the expected negative effects of climate change on Kenyan agriculture for producers and consumers (Worldbank 2015, FAO 2016).

## What is climate change?

Climate change (CC) is the long-term or permanent shift of average climatic conditions (FAO 2015). They result in changes of weather patterns and directly affect agricultural production. Kenya is highly vulnerable to the impacts of climate change. Some of the most visible changes are:

- Increase in mean temperature;
- Shifts in the onset and end of the rainy seasons;
- Changes in duration, amounts and intensity of rainfall;
- Higher frequency of droughts and floods;
- Changing strength and direction of winds;
- Higher temperatures and stronger solar radiation;
- Occurrence of more and new pests and diseases (FAO 2015, Worldbank 2015).



Kenya's agriculture is especially vulnerable to climate changes<sup>1</sup> because of its large dependence (98%) on rainfed agriculture (Worldbank 2015). Depletion of water and pasture resources are expected consequences under which mainly smallholder farmers will suffer. They might lose income and livelihoods through crop failure and livestock losses. A 30% drop is expected for the productivity of crops, livestock, forestry, fisheries and aquaculture, endangering Kenya's food security and rural livelihoods (FAO 2015).

Mankind is, however, not only negatively affected by CC, they also contribute to it by emitting greenhouse gas (GHG) emissions to the atmosphere. Agricultural production is next to industry and transportation a key contributor to CC. Several activities, such as clearing land, burning of biomass or wood, some tillage practices or indiscriminate use of agro-chemicals all amplify the effects of CC by releasing GHG (FAO 2015, Worldbank 2015). On the other hand, agriculture has the potential to contribute to reducing GHG emissions. A variety of adapted agricultural practices, summed up under the term "climate smart agriculture", minimize harmful effects or even reduce emission or absorb GHG.

<sup>1</sup> However, more positively, such climate change projections suggest that, in some places, opportunities for crop diversification and intensification may emerge, including options for expanding into places where cultivation is not currently possible.

## Water harvesting

Water harvesting is the harnessing of rain or groundwater for agricultural purposes. A vast number of techniques allow flexibility and adaptability to site-specific situations to best fight water scarcity and make agricultural production more resilient (FAO 2015).

### What is it?

Zai Pits are shallow, wide, circular pits that combine water harvesting and conservation of moisture and fertility in the pit. Zai Pits are adequate for growing cereals (e.g. maize, millet or sorghum) or fodder in drier areas.

Retention Ditches are about 50 cm wide and 50 cm deep ditches dug along a contour, often used for growing banana but in bigger ditches also tree growing is possible. If the ditch is long, it may be graded to allow water to flow to the furthest end.

Catch pits of size 1 x 2 x 0.25 m are dug at suitable sites in slope areas. During rains, rain water is collected in the pits along with the silt.

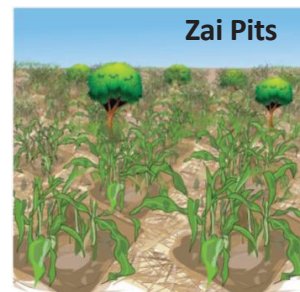
### Benefits/Why water Harvesting?

Zai Pits are useful for rehabilitating barren, crusted soils, and gentle clay slopes (below 2%), where infiltration is limited and tillage is difficult.

Retention Ditches and Basins allow to trap water and enable it to sink laterally into the soil.

Catch pits enhance moisture availability to the crops by catching and retaining rain falls and run offs. Thereby they also prevent erosion.

### Technology



**Zai Pits**

### Retention Ditches and Basins



**Catch pits**

## Water harvesting for drip irrigation

Water is collected and stored in a raised tank. When needed it is released through tubes with small holes placed directly at the plants.

Are preferred because of the abundance of water in some and scarcity in other seasons as they allow to store water for the dry season. Drip irrigation also saves a lot of water by well targeted water application and avoids evaporation (FAO 2015, FAO 2016).



**Drum Drip Kit**

Water is collected (e.g. from a river or well) and put in the buckets to drip irrigate the field.

Are preferred because of the abundance of water in some and scarcity in other seasons as they allow to store water for the dry season. Drip irrigation also saves a lot of water by well targeted water application and avoids evaporation (FAO 2015, FAO 2016).



**Bucket Drip Kit**

## How does water harvesting contribute to CSA?

Water harvesting practices' contributions to the three pillars of climate change differ significantly.

1. Increasing agricultural productivity and income: Harvesting water for irrigation helps crucially to increase production efficiency and yields per unit. It thereby provides yield stability throughout the year because water is normally the most limiting production aspect.
2. Enhancing resilience or adaptation of livelihoods and ecosystems towards climate extremes: Water harvesting and adequate irrigation enables crops or fodder to be grown despite inadequate rains, or outside growing seasons. Thereby it contributes significantly to strengthening resilience.
3. Reducing and removing GHG emissions from the atmosphere: Water harvesting and adapted irrigation can reduce methane emissions compared to inadequate ways to irrigate. For rice production in Kenya for example, FAO expects a high positive impact on carbon emissions through water-efficient irrigation techniques (Worldbank 2015, FAO 2016, FAO 2015).

The great advantage of rainwater harvesting is its ability to better use the available rainfalls. By storing the water or by facilitating its infiltration into soil, the soil moisture content can be improved and even re-accumulation of ground waters is possible by lowering the need to extract groundwater e.g. with wells (FAO 2015).

### Main sources:

Eastern Africa Climate-Smart Agriculture Scoping Study: Ethiopia, Kenya and Uganda. By Njeru, E., Grey, S. and Kilawe, E., Addis Ababa, Ethiopia, FAO 2016

Climate Smart Agriculture. Training Manual for Extension Agents in Kenya. FAO, Ministry of Agriculture, Livestock and Fisheries - State Department of Agriculture. FAO Kenya, 2015

Rawlin, Maurice, Abstract: [http://csa2015.cirad.fr/layout/set/resume/submission/I2\\_1\\_developing\\_and\\_evaluating\\_climate\\_smart\\_practices/developing\\_indicators\\_for\\_climate\\_smart\\_agriculture\\_csa](http://csa2015.cirad.fr/layout/set/resume/submission/I2_1_developing_and_evaluating_climate_smart_practices/developing_indicators_for_climate_smart_agriculture_csa)

Climate-smart agriculture in Kenya. CSA Country Profiles for Africa, Asia, and Latin America and the Caribbean Series. CIAT, World Bank, The World Bank Group, Washington D.C., 2015

<http://www.fao.org/docrep/U3160E/u3160e07.htm>

### Diagrams:

Page 1: CSA Pillars, CalCAN 2010; <http://calclimateag.org/what-is-climate-smart-agriculture/>

Page 2: Projected impacts of climate change on main crops in Kenya by 2030, Tegemeo Institute 2010

Page 3: Climate Smart Agriculture. Training Manual for Extension Agents in Kenya. FAO, Ministry of Agriculture, Livestock and Fisheries - State Department of Agriculture. FAO Kenya, 2015, pp. 36, 37, 38

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**In Cooperation with:**

